

# Application of RFID internet of things for school empowerment towards smart school

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## ABSTRACT

State Vocational High School (SMK) 1 Perhentian Raja is a school located in Hangtuh village which is known as a catfish-producing village in Kampar Riau Regency, which has a major in Computer Network Engineering (TKJ) and Fisheries Cultivation. After making direct observations to the location of the Community Partnership Program (PKM), we found various forms of partner problems in education services, including student absenteeism which is still manual. The teacher will call the students one by one and then marked by the teacher on the attendance sheet. This will use teaching time in the classroom and laboratory, as a result learning activities will be less effective. This problem is also faced by librarians, with low student visits to the library. Meanwhile, other problems are parking services and school security. the condition of the school is still new, the condition of the school is still open will have an impact on the weakness of school security. especially with parking conditions that are still scattered and not neatly arranged, it will provoke crime in schools. 95 percent of students and teachers using motorized vehicles to school will make it difficult for school guards to maintain the vehicle. The solutions offered to achieve this PKM goal are Smart School Socialization, Internet of Things (IoT) training, Radio Frequency Identification (RFID) technology workshops, RFID Technology Training for Student Attendance and School Libraries, Parking RFID Assembly Training, and School CCTV Installation Training. , RFID and CCTV Maintenance Workshop. The output targets to be achieved from this PKM can be felt by students, teachers and schools. RFID and CCTV technology will provide educational services and school security. This PKM activity will have an impact on improving the quality of education and become one of the reference schools in the Perhentian Raja sub-district, Kampar district.

## KEYWORDS

RFID;  
Internet of Things;  
Smart School;  
SMK N 1 Perhentian Raja



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## 1. Introduction

The current condition of partners in situation analysis, State Vocational High School (SMK) 1 Perhentian Raja has 2 majors, namely Computer Network Engineering (TKJ) and aquaculture. The school stands on a land area of 2 hectares. With the number of students as many as 225 people, the number of teachers and staff 22 people. School facilities such as 4 classrooms, 4 laboratories, library, sports facilities and parking. The partner location, SMK N 1 Perhentian Raja is located on Jalan Garuda, Hangtuh Village, Perhentian Raja Subdistrict, Kampar Regency. The location of the school which is known as the catfish-producing village in Kampar Regency. Partner problems faced by partners are 2, namely educational services [1] and School Security Parking. All solutions offered to partner problems are Smart Schools [2]. Smart School is a school application that integrates the entire system built into a school [3]. With the Smart School, it is hoped that it will facilitate the work of stakeholders related to schools [4]. The online learning model [5] using the smart school application can facilitate interaction between teachers and students in a student-centered teaching and learning process so that it can increase student learning motivation, build student independence in learning, facilitate the distribution of subject matter and assignments and deliver information quickly.

Several previous researchers have conducted research on Smart School. Towards Smart Schools: Comparison between Smart Schools and Traditional Schools for Mathematics Learning is researched by Taleb [6]. The Principal of Smart Schools and Smart Schools was studied by Ibrahim [7]. Opportunities for Applying GIS in Learning Geography: A Survey Among Smart Schools in Sabah, Malaysia researched by Singh [8]. Learning Culture in Smart Schools is researched by Attaran [9]. WCLTA 2011 The study of functional elements of management systems in smart schools was researched by Salimi [10]. The study of curriculum elements in smart schools was researched by Ghonoodi [11]. The study and comparison of curriculum in smart and traditional schools was researched by Salimi [12]. Comparing the self-concept of education of normal and smart high school students in Tehran was studied by Hosseinpour [13]. ICT and Diversity in Students' Attitudes in the Smart School Initiative were studied by Hamzah [14]. ICT implementation among Malaysian schools: GIS, barriers and opportunities researched by Lateh [15]. The importance of students' views on educational change was investigated by Hamzah [16]. Technology in Mathematics Teaching was researched by Khambari [17]. Mathematical creativity in the use of technology was researched by Idris [18]. Mathematics Self-Efficacy and Meta-Cognition Among Students was studied by Jaafar [19]. Peer Interaction in Computer Supported Collaborative Learning using Dynamic Mathematics Software researched by Wei [20].

One of the services in Smart School is learning media using Internet of Things (IoT) devices. Internet of Things (IoT) is a concept that aims to expand the benefits of continuously connected internet connectivity. Internet of Things (IoT) can be used in buildings to control electronic equipment such as operating room lights remotely via computer networks. A reconfigurable frequency domain antenna for COVID-19 tracking was investigated by Akinola [21]. The design of a Smart Home Security System using Object Recognition and PIR Sensors was investigated by Surantha [22]. IoT-based food and agricultural system architecture framework: A dual case study was investigated by Verdouw [23]. Encouraging economic growth, social inclusion, sustainability in Industry 4.0, a systemic approach is researched by Villar [24]. AAA-WSN: Anonymous access authentication scheme for wireless sensor networks in a big data environment was investigated by Nashwan [25]. The integration of digital learning in industry 4.0 was researched by Tvenge [26]. Websocket to Support Real Time Smart Home Applications researched by Soewito [27]. FMEA based remote monitoring and warning system of HV transformers was investigated by Asadi [28]. The parking diversion method based on Internet of Things and multi-word combination was investigated by He [29]. Designing a curriculum for the Internet-of-Things-Laboratory to encourage creativity and mind-setters in various target groups was researched by Lensing [30].

The development of a new framework for implementing Industry 4.0 in companies was researched by Dossou [31]. Recent trends in the status, challenges and potential of solid waste management for Indian cities in the future – A review researched by Kumar [32]. A data processing model for a mobile IoT system was investigated by Aung [33]. Industrial Communications based on Modbus and Node-RED were investigated by Tabaa [34]. Methods and concepts for elaborating decision aids to optimize the delivery flow of healthcare drugs were investigated by Pinheiro [35]. Towards smart manufacturing: Implementation and benefits researched by Haricha [36]. Smart cities and cybersecurity; the technology used, the main challenges and future recommendations were investigated by Ma [37]. The impact of Sustainability on supply chain performance 4.0 was investigated by Dossou [38]. The Survey of Trust Calculation Methods in the Internet of Things was researched by Najib [39]. Smart materials for smart healthcare– switching from sensors and actuators to self-contained nanoenergy nanosystems were researched by Arab Hassani [40].

One of the technologies used in IoT is RFID technology. Radio frequency identification (RFID) is a technology that uses communication via electromagnetic waves to change data between the terminal and an object such as a product, animal, or human for the purpose of identification and tracking through the use of a device called an RFID tag. RFID (Radio Frequency Identification) began to be developed as a

new technology that will make it easier for humans to identify various things, consisting of a tag in the form of a special chip that has unique information codes and a reader that functions to read the codes on the tag. . The RFID technology and its effect on the improvement of the technological process at the Ierna Nad Tisou station were investigated by Hranický [41]. Ruthenium (Ru) doping of zinc oxide nanostructure based on radio frequency identification (RFID) gas sensor for NH<sub>3</sub> detection was investigated by Ali [42]. Wireless Indoor Localization Using Passive RFID Tags was investigated by Diallo [43]. RFID Key Technology for Humanity was researched by Duroc [44]. The RFID tag on the operation of the fire station was investigated by Galko [45]. Placement of metal parts in a room with fingerprints using passive RFID was investigated by Ghadge [46]. A dataset survey on combining RFID with cellular technology for the safety of efficient construction professionals was researched by Osunsanmi [47]. An RFID-based food rationing system was investigated by Kumar [48]. Using radio frequency identification and locomotor activity monitoring to assess sleep, locomotor and foraging rhythms in bees was studied by Tasman [49]. The identification of radio frequency without chip of electromagnetic spectrum was investigated by Li [50].

Cybersecurity in Brain-Computer Interface: The theoretical framework of RFID-based design was researched by Ajrawi [51]. Buildings as a material bank using RFID and building information modeling in a circular economy were investigated by Copeland [52]. The integration and testing of the RFID-enabled Smart Factory concept in the Learning Factory was investigated by Mladineo [53]. Monitoring through visits of growing pigs with UHF-RFID was investigated by Adrion [54]. E-RFIDuino: An Arduino-based RFID environmental station for monitoring cellular tags was investigated by Cassel [55]. In-situ measurement in the distribution chain of iron ore pellets using active RFID technology was investigated by Bergquist [56]. RFID-enabled video tracking for automated analysis of social behavior in a group of mice was studied by Peleh [57]. Pre-flight inspection of aircraft emergency equipment via RFID technology was investigated by kultý [58]. Design of Tracking System for Prefabricated Building Components using RFID Technology and CAD Model researched by Naranje [59]. Planning of RFID Readers for Predictable Surveillance of Mobile Objects researched by Zhu [60].

The RFID technology used is equipped with a Raspberry Pi. Raspberry Pi is one of the components of the Internet of Things (IoT) that can be applied as a remote controller with an internet network that can be applied to electronic equipment such as lights. These devices can be accessed with internet services via android smartphones with Internet Protocol so that the level of energy efficiency and working hours of officers and in terms of saving electrical energy used. Priority solutions for Education Services and Security Parking Services with several trainings and workshops, namely Smart School Socialization, Internet of Things (IoT) training, Radio frequency identification (RFID) technology workshops, RFID Technology Training for Student Attendance and School Libraries, Parking RFID Assembly Training , and Training on installation of school CCTV, RFID and CCTV Maintenance Workshop.

## 2. Method

Implementation activities for 7 days at school. The material is delivered in the form of presentation slides, material videos, practicum and evaluation through pre-test and post-test. using presentation media through infocus and sound system. All of these PKM activities use rented cars as a medium for school transportation. Higher education partners are preparing competent lecturers in their respective fields, namely the fields of computers, engineering and education. Accompanied by 2 active students from partner universities. School partners, namely providing a place for training activities and workshops. Participants from students, teachers and employees. And other preparations to support this PKM activity. Evaluation of program implementation and PKM sustainability. Evaluation of the implementation starting from the pre-test and post-test activities by PKM activity participants. The sustainability of this PKM will be applied to other fields such as other fields of internet of things. Partner universities will always support directly and indirectly.

The method of implementation in several stages to solve partner problems both directly and indirectly in implementing new technology in schools. There are 7 implementations to solve problems in partners. The first implementation method is by conducting School CCTV Installation Training on PKM in schools with a focus on students, teachers and employees. The second implementation method is by conducting school CCTV Maintenance Training on PKM in schools with a focus on students, teachers and employees. The third implementation method is by conducting Smart School Socialization on PKM in schools through online webinars with a focus on students, teachers and employees. The fourth implementation method is to perform maintenance and assembly of RFID attendance at PKM in schools with a focus on students, teachers and employees. The fifth implementation method is to disseminate RFID technology to PKM in schools through online webinars with a focus on students, teachers and employees. The sixth implementation method is by conducting Internet of Things (IoT) socialization on PKM in schools through online webinars with a focus on students, teachers and employees. The seventh implementation method is by installing RFID Student attendance at PKM in schools with a focus on students, teachers and employees.

### 3. Results and Discussion

The CCTV Installation Training Activities for Schools are shown in Fig. 1. The picture shows that the CCTV installation training was delivered by the PKM team, namely Yoyon Efendi, M.Kom, Syahrul Imardi, MT, Muhammad Syaifullah, M.Kom and Rometdo Muzawi, M.Kom accompanied by 2 people students of Muhammad Anip and Rivaldi Akbar. This training was given to 30 representatives of students, teachers and employees. This activity is carried out for 1 day starting from 08.00 - 16.00 WIB. This training includes the following materials: CCTV Sequencing, CCTV Testing, CCTV Server Installation, CCTV Monitor Monitoring, and CCTV Evaluation.



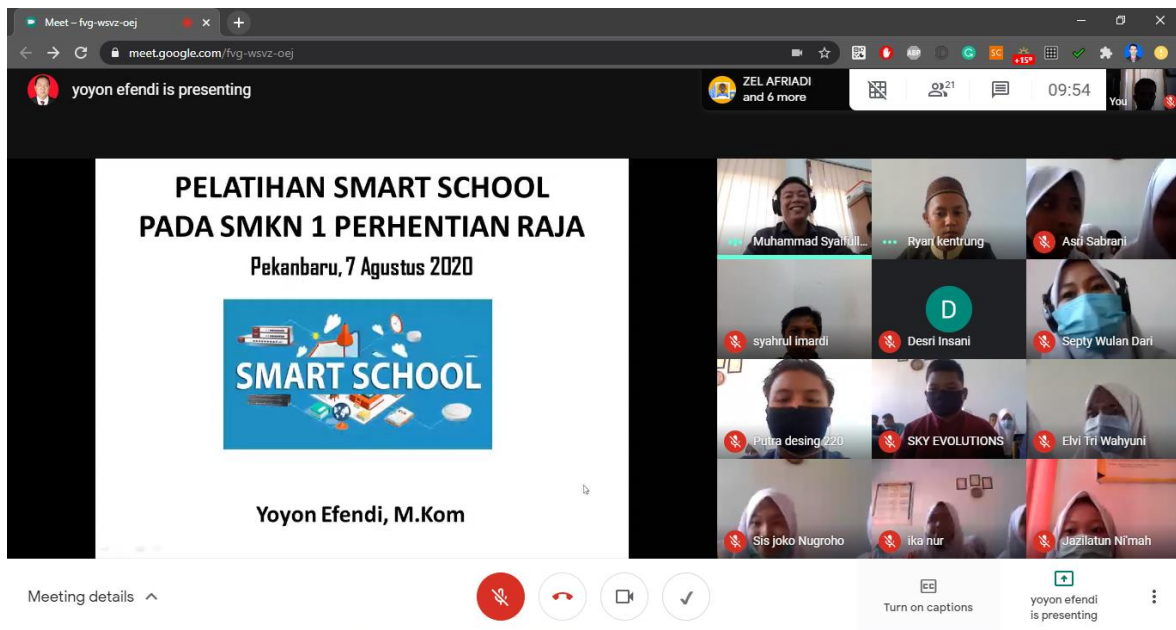
Fig. 1. Participants take part in the CCTV cable installation practicum session

The school CCTV maintenance training activities are shown in Fig. 2. The picture shows that the event started with the Delivery of 4 Channel Outdoor CCTV Packages by the Chairperson of PKM Yoyon Efendi, M.Kom and CCTV maintenance training delivered by the PKM team, namely Yoyon Efendi, M.Kom, Syahrul Imardi, MT, Muhammad Syaifullah, M.Kom and Rometdo Muzawi, M.Kom accompanied by 2 students, Muhammad Anip and Rivaldi Akbar. This training was given to 30 representatives of students, teachers and employees. This activity is carried out for 1 day starting from 08.00 - 16.00 WIB. This training covers CCTV server maintenance, CCTV recording and Mobile online CCTV.



**Fig. 2.** Delivery of 4 channel outdoor CCTV packages by PKM chair Yoyon Efendi, M.Kom

The smart school socialization activity is shown in Fig. 3. The picture shows that the socialization was delivered by the PKM team, namely Yoyon Efendi, M.Kom which was given to 20 representatives of students, teachers and employees. This activity is carried out for 1 day starting from 09.00 - 12.00 WIB (Webinars). This socialization begins by doing several stages, namely a pretest is carried out to find out the extent of the knowledge of school residents about smart schools. Socialization activities with Smart School technology presentations. Post-test activities were carried out to determine the effect of socialization carried out whether there was an increase in knowledge about smart schools.



**Fig. 3.** Smart school socialization activities will be delivered by Yoyon Efendi

The Internet of Things (IoT) socialization activity was delivered by the PKM team, namely Syahrul Imardi, MT which was given to 20 representatives from students, teachers and employees. This activity was continued with the PKM Opening which is shown in Fig. 4. The picture shows that the PKM Opening event was opened by the Deputy Head of Public Relations. This activity is carried out for 1 day starting from 09.00 - 12.00 WIB (Webinars). this training with material on IoT Concepts, Application of IoT in schools and school IoT in the application of Smart Schools (Smart School).



**Fig. 4.** Group photo at the PKM opening event which was opened by the deputy head of public relations

The RFID Technology Socialization activity was delivered by the PKM team, namely Rometdo Muzawi, M.Kom which was given to 20 representatives of students, teachers and employees as shown in Fig. 5. The picture shows that the delivery of RFID attendance to the school principal. This activity is carried out for 1 day starting from 09.00 - 12.00 WIB (Webinars). This workshop covered RFID Concepts, RFID Hardware, RFID Assembly and Simulation and Application of RFID in Schools.



**Fig. 5.** Submission of RFID attendance to the principal

Student attendance RFID installation activities were delivered by the PKM team, namely Yoyon Efendi, M.Kom, Syahrul Imardi, MT, Muhammad Syaifullah, M.Kom and Rometdo Muzawi, M.Kom accompanied by 2 students Muhammad Anip and Rivaldi Akbar shown in Fig. 6. It can be seen that the installation of RFID cards to students by the waka curriculum. This training was given to 30 representatives of students, teachers and employees. This activity is carried out for 1 day starting from 08.00 - 16.00 WIB. This training includes material for handing over RFID attendance, handing over RFID cards, installing RFID cards symbolic to students, testing and testing RFID and evaluating RFID.



**Fig. 6.** Installation of RFID cards to students by the head of curriculum

The maintenance and assembly of RFID attendance activities were delivered by the PKM team, namely Yoyon Efendi, M.Kom, Syahrul Imardi, MT, Muhammad Syaifullah, M.Kom and Rometdo Muzawi, M.Kom accompanied by 2 students Muhammad Anip and Rivaldi Akbar as shown in Fig. 7. The picture shows that there are two students. Direct practice of assembling tools. This training was given to 30 representatives of students, teachers and employees. This activity is carried out for 1 day starting from 08.00 - 16.00 WIB. This training covers RFID Maintenance, RFID Assembly, RFID Cabling and Maintenance Evaluation and troubleshooting.



**Fig. 7.** Direct practice of assembling tools

The results of the Pre-Test and Post-Test of Smart Schools with Internet of Things and RFID for Students are shown in Fig. 8. The Fig. 8 shows that the pre-test of student knowledge about this technology is very low, it can be seen from 20 students there are 16 correct 1 answer, 2 are 2 answers and 2 are correct 3 answers. After being given the material and post-test practicum there was a very significant increase with 2 people who answered 3 correct answers, 3 people 4 correct answers and 15 correct all answers.

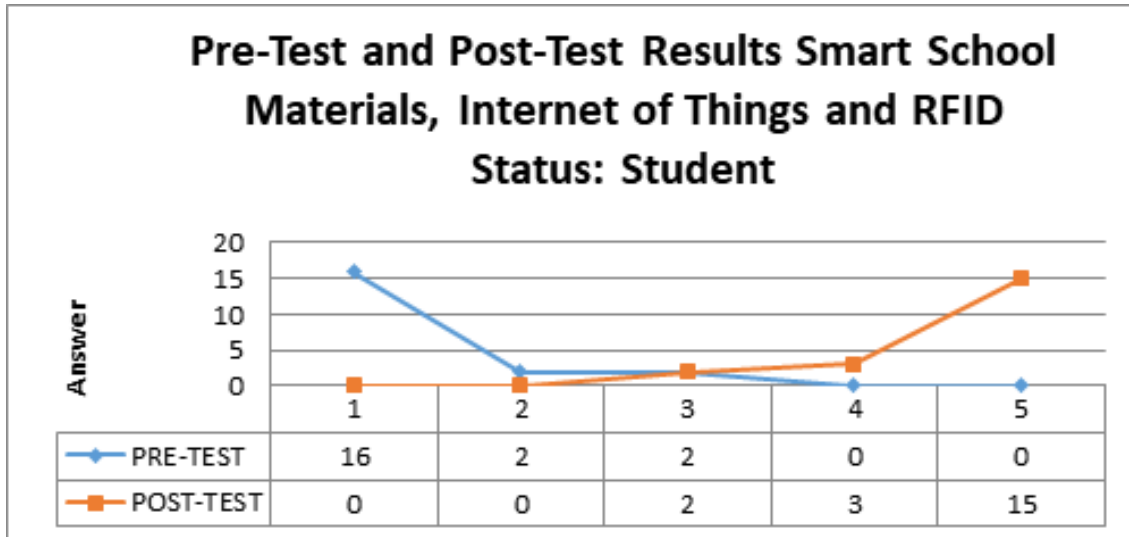


Fig. 8. Pre-Test and post-test results smart school materials, internet of things and RFID status: student

The results of the Pre-Test and Post-Test of Smart Schools with Internet of Things and RFID materials for workers and teachers are shown in Fig. 9. The picture shows that the pre-test knowledge of teachers/employees is very low about this technology, it can be seen from 10 people there are 8 people 1 correct answer, 1 person 2 answers and 1 person correct 3 answers. After being given the material and post-test practicum there was a very significant increase with 1 person 4 correct answers and 9 correct all answers.

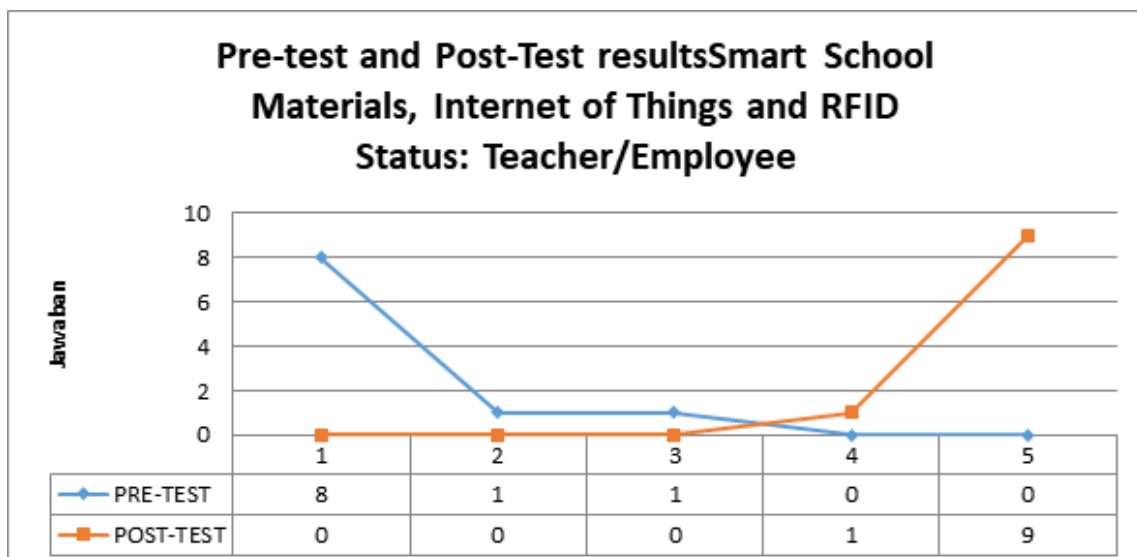


Fig. 9. Pre-test and post-test results smart school materials, internet of things and RFID status: teacher/employee

#### 4. Conclusion

Implementation of Community Service Program Activities at SMK Negeri 1 Perhentian Raja has been carried out with several stages of activity, starting from a preliminary visit to each target group, agreeing on problems and solutions to be implemented, assembling hardware and software, and conducting trials. In general, it can be concluded that this service is one of the right technologies and products in the form of a smart school RFID hardware application with an online attendance system that can be applied at SMK Negeri 1 Perhentian Raja. Smart school RFID hardware with online attendance systems can improve the quality of education, because teachers, and parents of students can supervise students anytime and anywhere, not only limited to classrooms. It can create an effective and efficient learning culture/environment also paperless. Smart school does not mean replacing conventional learning models in the classroom, but applying technology that can help teachers in online learning media towards smart schools. Accelerate vocational high schools in providing information on online attendance services and delivery to students and parents about the progress and achievements of each student so as to improve the performance and quality of academic services.

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#### Author contribution

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#### Conflict of interest

The authors declare no conflict of interest.

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